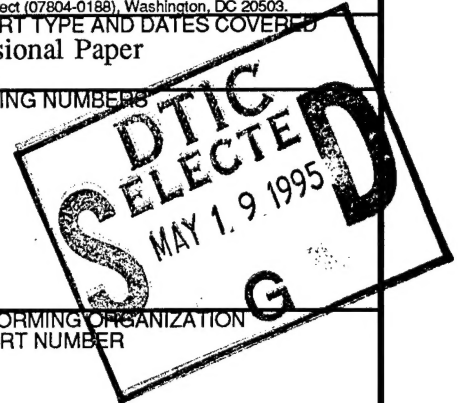


REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate only, other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (07804-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (LEAVE BLANK)		2. REPORT DATE 27 April 1995		3. REPORT TYPE AND DATES COVERED Professional Paper
4. TITLE AND SUBTITLE Night Vision for the F-14 Tomcat			5. FUNDING NUMBERS	
6. AUTHOR(S) CDR Mike Rabens, USN and LT Dave Klaasse, USN			8. PERFORMING ORGANIZATION REPORT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) DEPARTMENT OF THE NAVY NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION PATUXENT RIVER, MARYLAND 20670-5304			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) NAVAIRWARCENACDIV Warminster began working on an integrated Tomcat NVIS compatible cockpit nearly 8 years ago. This effort continued for many years and would have ultimately been incorporated into the Block I upgrade to the F-14. However, F-14 upgrade plans changed, and the Warminster efforts shifted to designing a nonintegral (and less expensive) NVG cockpit. Independently, several years ago, the Red Rippers of VF-11 set out to find a low cost NVG compatible kit for their F-14D's. Working with industry to design a proof of concept cockpit, they successfully enlisted the help of a manufacturer and installed NVIS filters over many of their displays. Finally, in 1994, the F-14 Program Manager initiated a program to develop NVIS compatible cockpit lighting kits for the F-14 series using the best of the Warminster and VF-11 developed components.				
14. SUBJECT TERMS F/A-18, Night Vision Goggles, A-6E Intruders, NVG			15. NUMBER OF PAGES 5	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	



<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Codes		
Dist	Avail and/or	Special
A-1		

19950518 045

DTIC QUALITY INSPECTED 6

NIGHT VISION FOR THE F-14 TOMCAT

by

Commander Mike Rabens, USN and Lieutenant Dave Klaasse, USN

It's the third night of the war. You are leading a division of Tomcats on a self-escorted Strike of an enemy airfield. The enemy has repositioned their fighters to a remote base and intelligence reports that their aircraft will be on the ramp exposed all night. The weather is clear. Armed with four Rocketeers, two Sparrows, and two Sidewinders each, and equipped with Night Vision Goggles, you can see the airfield and strike with lethal accuracy.

Tasking has come down from the CINC to get imagery of merchant shipping that is suspected of carrying Silkworm missiles into a foreign harbor. The catch is, the vessels are running at night with no lights. Equipped with Night Vision Goggles, the Tomcat's radar, and the AAD-5 Infrared Line Scanner, Tactical Air Reconnaissance Pod Tomcats can search, find, and image the ships before they can hide their cargo.

INTRODUCTION. Naval tactical aircraft have been flying with night vision goggles (NVG's) since 1986 when VA-65 deployed in A-6E Intruders with NVG's. Shortly thereafter, the F/A-18 Hornet Night Attack Program commenced. Today, Marine F/A-18D and AV-8B, Navy F/A-18C strike fighters, and some of the remaining venerable A-6E's train and operate using NVG's on a regular basis.

Years of experience have shown all Night Vision Devices and NVG's, in particular, to be a tremendous situational awareness enhancer, a valuable aid to night tactics, and an effective tool to use with other sensors to operate effectively at night. This experience has also proven that, like all tools, NVG's are not the panacea. NVG's require some finite amount of light to operate, are affected by weather, and come with some rather important human factors limitations. Still, the advantages outweigh the disadvantages, and, on balance, everyone agrees that NVG's are now an essential tool in the tactical aircraft tool kit.

The Naval Air Warfare Center Aircraft Division (NAVAIRWARCENACDIV), Patuxent River recently completed developmental testing of a Night Vision Imaging System (NVIS) compatible lighting kit for the F-14 aircraft. These kits were developed and tested for the F-14A and F-14D, and can now be manufactured and installed in any variant of the F-14.

BACKGROUND. NAVAIRWARCENACDIV Warminster began working on an integrated Tomcat NVIS compatible cockpit nearly 8 years ago. This effort continued for many years and would have ultimately been incorporated into the Block I upgrade to the F-14. However, F-14 upgrade plans changed, and the Warminster efforts shifted to designing a nonintegral (and less expensive) NVG cockpit.

CLEARED FOR
 OPEN PUBLICATION
 APR 27 1995
 Dave A. Gilman
 PUBLIC AFFAIRS OFFICE
 NAVAL AIR SYSTEMS COMMAND
 AS AMENDED

Enclosure (1)

NIGHT VISION FOR THE F-14 TOMCAT

by

Commander Mike Rabens, USN and Lieutenant Dave Klaasse, USN

It's the third night of the war. You are leading a division of Tomcats on a self-escorted Strike of an enemy airfield. The enemy has repositioned their fighters to a remote base and intelligence reports that their aircraft will be on the ramp exposed all night. The weather is clear. Armed with four Rockeyes, two Sparrows, and two Sidewinders each, and equipped with Night Vision Goggles, you can see the airfield and strike with lethal accuracy.

Tasking has come down from the CINC to get imagery of merchant shipping that is suspected of carrying Silkworm missiles into a foreign harbor. The catch is, the vessels are running at night with no lights. Equipped with Night Vision Goggles, the Tomcat's radar, and the AAD-5 Infrared Line Scanner, Tactical Air Reconnaissance Pod Tomcats can search, find, and image the ships before they can hide their cargo.

INTRODUCTION. Naval tactical aircraft have been flying with night vision goggles (NVG's) since 1986 when VA-65 deployed in A-6E Intruders with NVG's. Shortly thereafter, the F/A-18 Hornet Night Attack Program commenced. Today, Marine F/A-18D and AV-8B, Navy F/A-18C strike fighters, and some of the remaining venerable A-6E's train and operate using NVG's on a regular basis.

Years of experience have shown all Night Vision Devices and NVG's, in particular, to be a tremendous situational awareness enhancer, a valuable aid to night tactics, and an effective tool to use with other sensors to operate effectively at night. This experience has also proven that, like all tools, NVG's are not the panacea. NVG's require some finite amount of light to operate, are affected by weather, and come with some rather important human factors limitations. Still, the advantages outweigh the disadvantages, and, on balance, everyone agrees that NVG's are now an essential tool in the tactical aircraft tool kit.

The Naval Air Warfare Center Aircraft Division (NAVAIRWARCENACDIV), Patuxent River recently completed developmental testing of a Night Vision Imaging System (NVIS) compatible lighting kit for the F-14 aircraft. These kits were developed and tested for the F-14A and F-14D, and can now be manufactured and installed in any variant of the F-14.

BACKGROUND. NAVAIRWARCENACDIV Warminster began working on an integrated Tomcat NVIS compatible cockpit nearly 8 years ago. This effort continued for many years and would have ultimately been incorporated into the Block I upgrade to the F-14. However, F-14 upgrade plans changed, and the Warminster efforts shifted to designing a nonintegral (and less expensive) NVG cockpit.

Independently, several years ago, the Red Rippers of VF-11 set out to find a low cost NVG compatible kit for their F-14D's. Working with industry to design a proof of concept cockpit, they successfully enlisted the help of a manufacturer and installed NVIS filters over many of their displays. Finally, in 1994, the F-14 Program Manager initiated a program to develop NVIS compatible cockpit lighting kits for the F-14 series using the best of the Warminster and VF-11 developed components.

NVIS KIT DESCRIPTION. Building on lessons learned from the A-6, F/A-18, and AV-8 programs, the final F-14 kit uses blue-green flood lights to externally illuminate an flight and engine instruments and the fuel gauges. Consoles are also lit with blue-green floods. Existing red or white back lighting is retained, but is simply turned off by the pilot and Radar Intercept Officer (RIO) when using goggles. All CRT type displays have either an internal or external filter. In the F-14A, the HUD, Vertical Display Indicator, Horizontal Situation Display, Tactical Information Display (TID), Detail Data Display, and Electronic Countermeasures Display are filtered. The F-14D Multifunction Displays (MFD's) are NVIS compatible, so only the HUD and TID require filters. Mission related enunciator or indicator lights, Weapons Control System pushtile lights, and all safety-of-flight warning, caution, and advisory lights are modified with NVIS filters to make them compatible with the goggles. Pictures of the F-14A front and rear cockpits are shown in figures 1 and 2.

NIGHT VISION GOGGLES. This program used the MXU-810/U Mark-IV Cats Eyes NVG's, manufactured by GEC Avionics Corporation of Rochester, England, with Generation III (GEN III) image intensifier tubes. These are the units currently in use by TACAIR in the fleet. They amplify light in the 600 to 900 nanometer range up to 30,000 times, with 36 line-pair per millimeter resolution (0.87 cycle/milliradian) at a 30° FOV.

GROUND TESTS. Ground testing of both the F-14A and F-14D cockpits was accomplished at Patuxent River using the Aircraft Test and Evaluation Facility, a light-tight test hangar that has a test lighting rig that can emulate conditions from below mean starlight through to a full moon.

These ground tests verified that the enunciator, warning, caution and advisory light filters, instrument filters, and flood lights were compatible with the Cats Eye NVG's.

FLIGHT TESTS. To expedite testing, the F-14 program manager directed that developmental testing (DT) and operational testing (OT) be flown concurrently. One pilot and RIO from the Strike Aircraft Test Squadron, Patuxent River, Maryland, and one pilot and RIO from Air Test and Evaluation Squadron Nine, Point Mugu, California, were trained in NVG employment using F/A-18D night attack aircraft.

Flight testing started with one day and one night flight to verify unaided (non-NVG) readability. These were followed by DT and OT flights evaluating F-14 NVG compatibility for visual navigation routes, straight path and pop-up weapons deliveries, air to air intercepts and formation flying. Testing was conducted with varying ambient light illumination ranging from below mean starlight (no moon) to a full moon. Testing was limited to an absolute floor of 3,000 ft AGL. F-14A testing was completed in December 1994 and F-14D testing was completed in February 1995.

FLIGHT TEST RESULTS. Results generally exceeded the test team's expectations. The CRT type filtered displays were all excellent. Blue-green flood lights were enhancing to the night readability of all instruments. In fact, they were very pleasant to the eye, much less fatiguing than the standard red floods. Also, the various warning, caution, advisory, and indicator lights all worked very well.

Two problems identified during F-14A testing were corrected and proven during F-14D testing. These included modifying the Low Altitude Warning System light in the Radar Altimeter and blocking a small portion of one of the three anticollision lights that was continually bathing the cockpit in noncompatible red light. The modified anticollision light scheme retains full spherical external coverage.

Some fine tuning of the flood light positioning and some caution light color changes were also a product of the flight test effort.

The current windscreen in the F-14 is not designed to be fully transmissive in the frequency range that the NVG's operate in. Because of that, the F-14 will have some altitude or ambient lighting restrictions until more experience can be gained in tactical employment. Fortunately, the next generation of NVG's may completely compensate for this transmissivity characteristic.

Overall, flight testing demonstrated that the NVIS cockpit kit, in conjunction with NVG's, will allow the F-14 to operate safely and more effectively in all required night mission areas.

MISSION ENHANCEMENTS. Mission capability enhancements afforded by NVG's include:

- Tactical integration with other Carrier Air Wing night strike assets.
- Covert intercept capability.
- Night visual identification aid.
- Enhanced night reconnaissance capability.
- Airborne Forward Air Controller enhanced night target identification and tracking.
- Air-to-ground weapon delivery at night (in VMC) using modified daylight tactics.
- Improved probability of night target acquisition.
- Combat search and rescue aid.

CURRENT STATUS. Two modified F-14's are currently flying with NVIS cockpits. The Gunfighters of VF-101, the F-14 Fleet Replacement Squadron, have a modified F-14A and the Red Rippers of VF-11 have a modified F-14D. Strike Weapons and Tactics School Atlantic and VF-101 are training instructors in anticipation of a fleet squadron being chosen for a

demonstration program. When funding is identified, a squadron or two may be equipped with NVIS lighting kits early next year for the fleet demonstration program. The long range plan is to modify a large percentage of deployable F-14's with NVIS compatible lighting kits.

Future Tomcat Night Vision improvements include possible incorporation of next generation goggles, such as Super ANVIS or Advanced Cats Eye, and the possible retrofit of a night attack single piece windscreen in the F-14D. Both of these enhancements would upgrade the already proven mission capability enhancements of NVG's.

SUMMARY. As the end of this century approaches, the Tomcat motto "Anytime, Baby" is more accurate than ever.

CDR Rabens and LT Klaasse are assigned as the NAVAIRWARCENACDIV project test team for F-14 NVG applications. CDR Rabens has over 2500 F-14 flight hours and nearly 60 NVG hours. LT Klaasse has over 1000 F-14 hours and nearly 60 NVG hours. Both are graduates of the U. S. Naval Test Pilot School.